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APPLICANT : SUMITOMO CHEM CO LTD;

INVENTOR : MAEDA YASUTERU;

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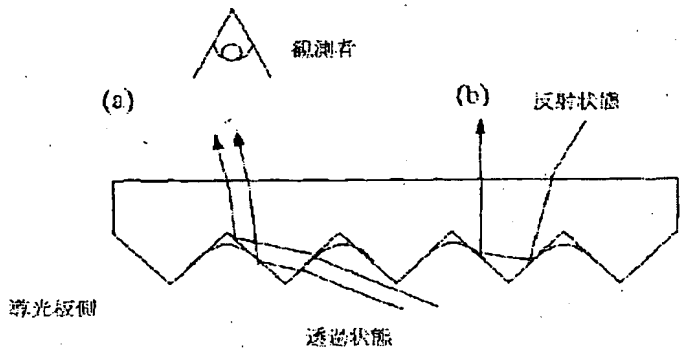
TITLE : OPTICAL MEMBER HAVING REFLECTION FUNCTION AND TRANSMISSION FUNCTION



ABSTRACT : PROBLEM TO BE SOLVED: To provide a transmission reflector, a transmission and reflection type polarizing plate and a transmission and a reflection type liquid crystal display device, using these plates such that the transmission and reflection performance and the diffusing function in the front face direction of the transmission reflector having a rugged surface are optimized with proper balance, that when these plates are attached to a transmission and reflection type liquid crystal display device, superior brightness and visibility in the front face direction are obtained for both of the transmission mode and reflection mode.

SOLUTION: (1) The transmission reflector is obtained by forming a resin layer on a rugged face in the opposite side to the observer's side of a planar member having the following properties. The planar member has a rugged surface and shows 100% sum of the transmittance for the light through the rugged face side and the reflectance for the light from the opposite face side. (2) The transmission and reflection type polarizing plate has a polarizing plate, disposed on the opposite side to the rugged face, where the resin layer is formed of the transmission reflector described in (1). (3) The transmission and reflection type liquid crystal display device is manufactured, by disposing the transmission reflector described in (1) or the transmission and reflection type polarizing plate described in (2) between the light exiting face of a back illumination type source unit and the liquid crystal display part with the rugged face of the plate, the resin layer is formed facing the light exiting face of the back illumination type light source unit.

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OPTICAL COMPONENT HAVING REFLECTIVE FUNCTION AND TRANSMISSION FUNCTION

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Translation Requested by: Kim Elfstrom 3M

Translation Provided by: Yoko and Bob Jasper
Japanese Language Services
16 Oakridge Drive
White Bear Lake, MN 55110

Phone (651) 426-3017 Fax (651) 426-8483
e-mail: jasper.jls@comcast.net

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OPTICAL COMPONENT HAVING REFLECTIVE FUNCTION AND TRANSMISSION FUNCTION

[*Hanshakinoh oyobi tohkakinoh o yuhsuru kohgakubuzai*]

Inventor(s):

Makoto Kuwahara
c/o Sumitomo Chemical
Co., Ltd.
6 KItahara, Tsukuba-shi
Ibaragi-ken

Yasuteru Maeda
c/o Sumitomo Chemical
Co., Ltd.
6 KItahara, Tsukuba-shi
Ibaragi-ken

Applicant(s):

000002093
Sumitomo Chemical
Co., Ltd.
4-5-33 Kitahama
Chuo-ku, Osaka-shi
Osaka-fu

Agent(s):

100093285
Takashi Kuboyama
Patent attorney
and 2 others

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[*There are no amendments to this patent.*]

[*Translator's Note: Source of underlining is unknown.*]

[Translator's Note: Names of products and companies are spelled phonetically in this translation.]

Specification

[Title of the invention]

Optical component having a reflecting function and a transmitting function

[Abstract]

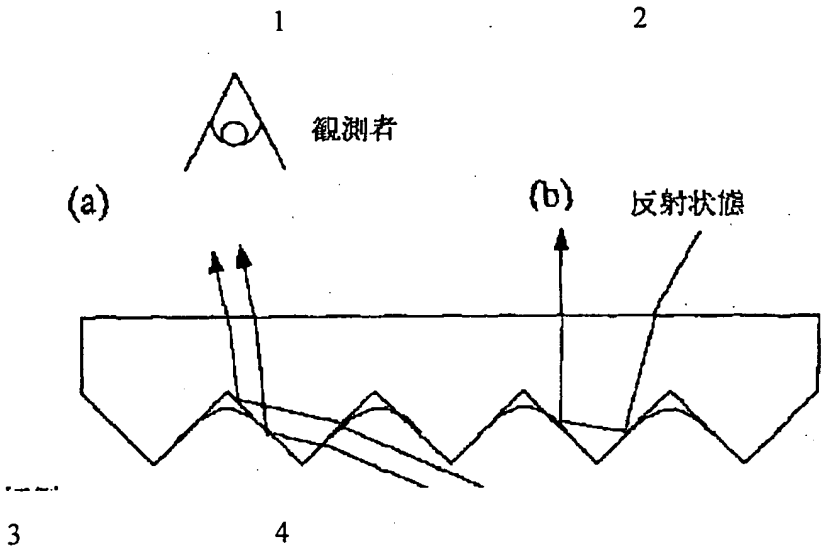
[Purpose] The purpose of the present invention is to provide a transmitting reflector and a transmitting reflective polarizing plate with high brightness and high viewability from the forward direction for either transmission type or reflection type viewing when well-balanced optimization is provided for light transmitted, and reflection and diffusion of light in the forward direction of a transmitting reflector having a rough surface and a transmission reflection type liquid crystal display device utilizing same.

[Means of solution] (1) A transmitting reflector provided with a resin layer on a surface with peaks and valleys on the side opposite from the viewer of a planar component having a surface with peaks and valleys and the sum of the light transmittance at the surface with peaks and valleys and the reflectance of light from the opposite side is greater than 100%.

(2) A transmitting reflective type polarizing plate characterized by the fact that a polarizing plate is arranged on the transmitting reflector described in (1) above at the surface opposite from the surface with peaks and valleys provided with the resin layer.

(3) A transmitting reflective type liquid crystal display device characterized by the fact that the transmitting reflector described in (1) above or the transmitting reflective polarizing plate described in (2) above is arranged between the light transmitting surface and the liquid crystal display member of backlighted type display unit with the surface having peaks and valleys provided with the resin layer arranged facing in the direction of the light transmitting surface of

the backlighting type light source unit.



Key:

1: Viewer

2: Reflecting condition

3: Light guide plate side

4: Transmitting condition

[Claims of the invention]

[Claim 1] A transmitting reflector provided with a resin layer on a surface having peaks and valleys on the side opposite from the viewing side of a planar component having a surface with peaks and valleys and the sum of the light transmittance at the surface having peaks and valleys and the reflectance of light from the opposite side is greater than 100%.

[Claim 2] The transmitting reflector described in claim 1 characterized by the fact that the aforementioned surface having peaks and valleys has retroreflectivity.

[Claim 3] The transmitting reflector described in claim 1 or 2 in which the resin layer has

peaks and valleys and the cross-section of the valley has curvature forming an arc or bow or meniscus, and the thickness at the valley of the resin layer is 2/3 or less the height of the peak for a cross-section of the surface having peaks and valleys.

[Claim 4] A transmitting reflective polarizing plate characterized by the fact that a polarizing plate is arranged on the transmitting reflector described in one of claims 1 to 3 at the surface opposite from the surface having the peaks and valleys provided with the resin layer.

[Claim 5] A transmitting reflective type liquid crystal display device characterized by the fact that the transmitting reflector described in one of claims 1 to 3 or the transmitting reflective polarizing plate described in claim 4 is arranged between the light transmitting surface and liquid crystal display member of backlighting type light source unit as the surface having peaks and valleys provided with the resin layer arranged facing in the direction of the light transmitting surface of the backlighting type light source unit.

[Detailed description of the invention]

[0001]

[Technical field of the invention] The present invention pertains to a transmitting reflector and transmitting reflective polarizing plate capable of achieving high transmission and reflection, and a transmission reflection type liquid crystal display device utilizing same.

[0002]

[Prior art] In recent years, liquid crystal display devices are widely used in a variety of fields such as electronic notebooks, portable information terminals, amusement machines, and cell phones in addition to notebook type work processors and personal computers. Among those types of portable equipment, semi-transmitting reflective type liquid crystal display devices are widely used. The semi-transmitting reflective type liquid crystal display devices are used as reflective type displays that utilize natural light or room light during daylight hours (hereinafter referred to as reflective state) and work as transmitting type displays that utilize backlighting at night or in the dark (hereinafter referred to as transmitting state). For semi-transmitting

reflective type liquid crystal display device, those having a structure comprising a first polarizing plate/liquid crystal cell (TN cell, STN cell)/second polarizing plate/semi-transmitting reflector/backlighting unit are known.

[0003] For the semi-transmitting reflector used for the aforementioned display devices, a device is known that has a reflection function and a transmission function achieved when inorganic particles such as pearl mica, which has high refractive index, are dispersed in a matrix and light is reflected by the aforementioned particles to form a reflection state, and light is transmitted between the aforementioned particles to provide a transmission state. For example, a transmitting reflector provided with a pattern where the light-reflecting member and light-transmitting member are arranged alternatingly is described in Japanese Kokai [Unexamined] Patent Application No. Sho 55-103583. As a different example, a semi-transmitting reflective type polarizing plate produced by dispersing transparent and/or semi-transparent particles such as aluminum oxide, titanium oxide, aluminum powder, tin powder, gold powder or silver powder in an adhesive material layer is disclosed in Japanese Kokai [Unexamined] Patent Application No. Sho 55-46707. Furthermore, a liquid crystal display device provided with a prism sheet facing the backlight side as in the case of the present invention and the backlight is transmitted at the apex of the prism is disclosed in Japanese Utility Model No. Hei 5-59404 and Japanese Kokai [Unexamined] Patent Application No. Hei 11-224058.

[0004] Furthermore, a liquid crystal display device provided with a prism sheet facing the backlight side as in the case of the present invention and backlight is transmitted at the apex of the prism, the front face light is reflected inside the prism and transmission and reflection are achieved is disclosed in Japanese Kokai [Unexamined] Patent Application No. Hei 9-311332.

[0005]

[Problems to be solved by the invention] However, in a system where the distribution of transmitted light and reflected light is achieved based on scattering by particles as described in Japanese Kokai [Unexamined] Patent Application No. Sho 55-103583 and Japanese Kokai

[Unexamined] Patent Application No. Sho 55-46707, the transmission performance and reflection performance are in an inverse relationship; thus, when the semi-transmitting reflector is mounted in a semi-transmitting reflection type liquid crystal display device and used, brightness or viewability are not necessarily satisfactory. Fig. 1 shows the principle of a semi-transmitting reflector of the prior art where inorganic particles with a high refractive index such as pearl mica or particles with high reflectivity such as a metal are dispersed in a matrix. The lower part of Fig. 1 corresponds to the rear face and the upper part corresponds to the viewing side. As shown in Fig. 1, in the semi-transmitting reflector of the prior art, a portion of the light from the rear face is reflected by the inorganic particles or metal particles and returns to the rear face; thus, only the light that leaks through the particles is used in the transmission state, and lighting efficiency is low and an increase in transmittance is not possible. In other words, in order to achieve high transmittance, the quantity of particles included is reduced, and as a result, reflectivity is reduced. On the other hand, an increase in the quantity of particles is required to increase the reflectivity, in which case, transmittance is reduced. Therefore, the sum of the transmittance and reflectance is less than 100% in the semi-transmitting reflector of the prior art. In addition, a backlighting system is commonly used to form a transmission reflection type display in liquid crystal display systems, such as TN and STN, but the light emitted from the light guide plate has a certain degree of directionality when the backlighting system is used, and use of light with high directionality is conceivable when external light is used as well. In the case of a light source with high directionality, brightness varies significantly between the display in the light exiting direction where the light intensity is high and the light exiting direction where light intensity is low; thus, the reduction in viewability is a problem. Therefore, in order to improve viewability through adjustment of directionality in transmission type and reflection type viewing, installation of a diffuser is required while retaining high transmission and reflection. A transmission type liquid crystal display device with increased backlighting efficiency is achieved when the flat surface of a prism sheet is arranged facing the viewer and the prism surface is

arranged facing the light guide plate, and refraction and reflection by the prism are utilized and the collected light is emitted from the light guide plate toward the viewer is described in Japanese Utility Model No. Hei 5-59404 and Japanese Kokai [Unexamined] Patent Application No. Hei 11-224058, but use of the device as a reflective display device where backlighting is not used but the light from the viewing side is used based on the total reflection of prism is absent, and furthermore, the design of a diffusion plate that modulates the directionality of the reflected light from the prism is not taken into consideration.

[0006] Furthermore, a liquid crystal display device where the flat surface of a prism sheet faces the viewer and the prism surface of the prism sheet faces the rear is disclosed in Japanese Kokai [Unexamined] Patent Application No. Hei 9-311332. In the aforementioned publication, light from the viewing side is reflected with angular selectivity based on total reflection by the prism and the light from the rear side of the liquid crystal reaches the viewer with angular selectivity. However, in the aforementioned publication, backlighting is not used and use of the external light with low directionality is taken into consideration; thus, when backlighting commonly used for semi-transmitting reflective type liquid crystal display devices is applied in the device of the aforementioned publication, the backlighting with high directionality is strongly refracted in directions other than toward the front of the liquid crystal display device; thus, the brightness in the forward direction is reduced. Furthermore, the aforementioned publication is a display system based on a dispersed polymer type liquid crystal, and light scattering exists in the dispersed polymer type liquid crystal itself; thus, the diffusion function depends on light scattering based on the dispersed polymer type liquid crystal itself when external light with low directionality is used, and use of a diffusion plate is not mentioned.

[0007] The purpose of the present invention is to provide a transmitting reflector and transmitting reflective polarization plate with high brightness and high viewability from the front under either transmission conditions or reflection conditions when optimization is provided for light transmission and reflection and diffusion of light in the forward direction of a transmitting

reflector having a surface with peaks and valleys, and a transmitting reflector type liquid crystal display device utilizing same.

[0008]

[Means to solve the problem] As a result of much research conducted by the present inventors in an effort to eliminate the existing problems described above, the inventors discovered that an optical device with high brightness and high viewability from the front could be produced under either transmission conditions or reflection conditions when a transmitting reflector provided with a resin layer on the surface having peaks and valleys opposite from the viewing side of a planar component with a surface having peaks and valleys and the sum of the light transmittance at the surface having peaks and valleys and reflectance of light from the opposite side is greater than 100%; and, as a result, the present invention was accomplished.

[0009] In other words, the present invention offers features (1) to (3) below.

(1) A transmitting reflector provided with a resin layer on a surface having peaks and valleys on the side opposite from the viewing side of a planar component having a surface with peaks and valleys and the sum of the light transmittance at the surface having the peaks and valleys and the reflectance of light from the opposite side is greater than 100%.

(2) A transmitting reflective polarizing plate characterized by the fact that a polarizing plate is arranged on the transmitting reflector described in the above-mentioned (1) at the surface opposite from the surface having the peaks and valleys provided with a resin layer.

(3) A transmitting reflective type liquid crystal display device characterized by the fact that the transmitting reflector described in (1) above or the transmitting reflective polarizing plate described in the (2) above is arranged between the light exiting surface and the liquid crystal display member of the backlighting type light source unit while the surface having peaks and valleys provided with a resin layer is arranged facing in the direction of the light exiting surface of the backlighting type light source unit.

[0010]

[Embodiment of the invention] The present invention is explained in detail below. The optical component of the present invention is explained with reference to the drawings below but the present invention is not limited to the examples.

[0011] The present invention is explained in detail with an example using a prism sheet provided with a retroreflective surface with peaks and valleys having a cross-section shaped-like an isosceles right triangle on the surface. Fig. 2 is a cross-section view of the surface having peaks and valleys of the retroreflective sheet, and the bottom of the figure corresponds to the back side (backlight) of the liquid crystal display and the top corresponds to the viewing side. For the prism sheet with the aforementioned structure, a product known by the trade name "BEFII90/50" of Minnesota Mining and Manufacturing (3M) Co. is commercially available. In Fig. 2, a beam of light from the back of the prism sheet (rear side) undergoes refraction and most of the light is transmitted as shown in (a). On the other hand, light that enters the prism surface at an angle greater than the critical angle determined by the refractive index of the material of the prism and the angle of the prism among the light that enters from the flat surface side without the prisms (viewing side) as shown in (b) undergoes total reflection, and when the reflected light is incident on the other prism surface at an angle greater than the critical angle, total reflection occurs a second time, and the beam of light is reflected and passes out of the prism sheet at the flat surface. Depending on the refractive index of the material used for the prism and direction of incident light, both reflections can be total reflections, and in this case, the reflectance can be increased significantly. Furthermore, the cross-section of the above-mentioned BEFII90/50 film has the shape of isosceles right triangles with apex angles of 90°; thus, the direction of the light entering in a plane that crosses a prism row and the direction of the reflected light are parallel and retroreflection occurs. Therefore, when the aforementioned surface having peaks and valleys is used, most of the light incident from the prism surface side undergoes refraction and exits the flat surface side of the film, and most of the light incident from the flat surface side is reflected toward the flat surface side as a result of retroreflection, thus, production of a

transmitting reflector having superior properties where the sum of the transmittance from the surface having peaks and valleys side (rear side) and the reflectance of light from the opposite side is greater than 100%.

[0012] Furthermore, in the above-mentioned prism film, retroreflection does not occur when the apex is other than 90°, but an adjustment of the angle of the prism is made possible so that the total reflective condition can be achieved for light the incident from the smooth surface side, and an increase in reflectance is possible, and furthermore, an increase in light transmittance for light incident on the surface having peaks and valleys is made possible as well, and production of a transmitting reflector having the sum of reflectance and transmittance greater than 100% is made possible. The aforementioned transmitting reflector can be mounted onto a liquid crystal display device with backlighting to form a semi-transmitting reflector type liquid crystal display device, and high transmittance can be achieved when used under transmission conditions with dark surroundings and high reflectance can be achieved when used under reflection conditions with bright surroundings and an excellent transmission-reflection type liquid crystal display device can be produced.

[0013] The same effect can be achieved through adjustment of the shape and refractive index of the material used when a shape other than a [triangular] prism sheet is used, for example, polygonal cones or cones are used.

[0014] The term "retroreflection" is defined as a reflection where radiation is reflected back in the direction of incidence over a wide range of angles and returns toward the direction of incidence in the Optical Terminology Dictionary (Ohm Co.), but the retroreflection used in the present invention includes the retroreflection that occurs for light that enters from a specific plane alone, as well. Furthermore, in the present invention, it is regarded as retroreflection when the reflected light returns in a direction that is essentially parallel to the incidence beam rather than complete return of the reflected light toward the direction of incidence. In order to achieve the aforementioned retroreflection under the narrow definition, it is essential for the apex angle

to be 90° when a prism film is used, and when the reflected light returns in a direction that is essentially parallel to the direction of incidence, the apex may be approximately 90°. When a retroreflective prism is used for the surface having peaks and valleys, the light entering from the smooth surface side without the prisms undergoes retroreflection by the prisms; thus, it is reflected in the anti-parallel direction to the direction of incidence. Therefore, when the light enters from a direction near the forward direction of the film as shown in Fig. 2, the light is reflected toward the forward direction of the film, but when light enters from a direction other than forward direction of the film, the light is not reflected toward the forward direction of the film. In general, the direction of incidence of external light is 10° to 30° from the normal line to the display device under conditions where the semi-transmitting reflective type liquid crystal display is commonly used, thus, when the aforementioned transmitting reflector is mounted in a liquid crystal display device and used, an increase in brightness of the display device in the forward direction is not possible.

[0015] In the present invention, a resin layer is formed on the rear side of the planar component having a surface with peaks and valleys; in other words, on the surface having peaks and valleys opposite from the viewing side. The resin layer is formed in the recessed members, namely, the valleys, of the surface having peaks and valleys with a shape such as that shown in Fig. 3, for example. The principle is not well understood, but the present inventors discovered that retroreflectivity of the prism film was reduced without sharply reducing the reflectivity, and that light coming from the upper direction in Fig. 3, that is, natural light and room light from the viewing side that enters from a direction other than normal to the film, was emitted at a direction close to the normal to the film as well when the resin layer was formed. Furthermore, as shown in Fig. 3, the backlight beam from the lower part (rear side) is refracted at the resin layer and prism surface and is emitted in a direction close to the normal to the film. The trade-off relationship of transmittance and reflectance of the semi-transmitting reflector of the prior art where the total of transmittance and reflectance is less than 100% is eliminated, and a significant

increase in efficient use of light can be achieved in either the transmission state or reflection state and the transmitting reflector is capable of emitting light in a direction close to the forward direction under either reflection conditions or transmission conditions.

[0016] The planar component having a surface with peaks and valleys where the sum of light transmittance at the surface having peaks and valleys and reflectance of light from the opposite side is greater than 100% is explained in detail below, but needless to say, the present invention is not limited to the example.

[0017] For the shape of the surface having peaks and valleys on the planar component used in the present invention, a regular cone, oblique cone, pyramid and oblique pyramid, wedge shape, convex polygon, hemisphere, etc. can be mentioned and one or more structures having these partial structures can be mentioned. Furthermore, hemispheres, in this case, are not necessarily limited to perfect spheres and ellipsoids or modified convex shapes may be used as well. Furthermore, prism shape, lenticular lens shape, or Fresnel lens shape where the ridge lines of nonuniform shape are extended to form a line can be mentioned. The slant face of the aforementioned ridge line to the trough line may be flat, curved or a combination of the two. For example of the shape of the prism used in this case, a prism film having the cross-section shape of an isosceles right triangle having an apex of 90°, a prism film having a cross-section with the shape of an isosceles right triangle having an apex of 80 to 110°C, a prism film having a curved cross-section, etc. can be mentioned.

[0018] The height of the surface having peaks and valleys is not especially limited, and for example, approximately 10 μm to 1 mm is suitable when used for a liquid crystal display device from the standpoint of the panel dimensions. The structural cycle of the surface having peaks and valleys is not especially limited and for example, 1 μm to 100 μm, or 300 μm to 1 mm is suitable when used for liquid crystal display device from the standpoint of prevention of moire and non-uniform luminance.

[0019] As a method used for formation of the surface having peaks and valleys of the present

invention, for example, those listed below or other conventional methods may be used.

1) A method where the inverse die of the target shape is formed on a roll or original plate and the shape is applied by embossing.

2) A method where the inverse die of the target shape is formed on a roll or original plate, a thermosetting resin is filled in the negative, heated to cure and the inverse die is removed after curing.

3) A method where the inverse die of the target shape is formed on a roll or original plate, and ultraviolet or electron beam curable resin is coated to fill the recesses, ultraviolet or an electron beam is applied through the resin solution as the recessed members of the die are being coated to form the transparent base material and the cured resin base material film is removed from the inverse die.

4) A solvent casting method where the inverse die of the target shape is formed on a casting belt and the target shape is provided at the time of casting.

5) A method where a light-curable or heat-curable resin is printed onto a transparent substrate, and light or heat is applied to form a cured pattern.

6) A method where the surface is cut by cutting tools, etc.

7) A method where particles with shapes such as spherical or polygonal are partially embedded in the surface of the substrate to provide a surface having peaks and valleys on the substrate.

8) A method where a composition prepared by dispersing spherical or polygonal shaped particles in a small amount of binder coated onto the surface of the substrate to provide a surface having peaks and valleys on a substrate.

9) A method where a binder is coated onto the surface of the substrate and particles with a variety of shapes, for example spherical particles, are scattered over the surface to provide a surface having peaks and valleys on a substrate.

[0020] The resin layer formed on the surface having peaks and valleys of the present invention is explained in detail below. As described above, the total reflection condition is determined

according to the shape of the surface having peaks and valleys of the present invention, the material of the surface having peaks and valleys and angle of incidence of light, and an adjustment of the total reflection condition is made possible based on the refractive index of the resin layer formed on the surface having peaks and valleys. It is desirable when the refractive index of the resin layer formed on the surface having peaks and valleys and the refractive index of the material used for the surface having peaks and valleys is ±0.2 or less. For the type of resin layer formed on the surface having peaks and valleys of the present invention, thermoplastic resins, thermosetting resins, radiation-curable resins such as electron beam-curable resins, thermosetting resins, etc. can be mentioned. The aforementioned resins may be used independently or in combination.

[0021] For examples of thermoplastic resins that satisfy the above-mentioned refractive index conditions, resins such as polymethyl methacrylate, polycarbonate, polystyrene, polyvinyl alcohol, polyvinyl butyral, polyethylene terephthalate, polysulfone, polyallylate, polyether sulfone, ethyl cellulose, methyl cellulose, nitrocellulose, cellulose diacetate and cellulose triacetate, thermoplastic resins with low photoelastic factors known by trade names such as Arton, Xeonex and Xeonol, etc. can be mentioned, and for radiation curable resins and thermosetting resins, urethane acrylate resins, epoxy acrylate resins, urethane methacrylate resins, epoxy methacrylate resins, acrylic resins, epoxy resins, polyester resins, urethane resins, alkyd resins, etc. can be mentioned.

[0022] As for the formation method of the resin layer, a conventional method, for example, a method where the resin is dissolved in a solvent and coated onto a surface having peaks and valleys, a method where the resin is heated to a temperature above the softening point of the resin and formed on a surface having peaks and valleys, etc. can be mentioned when a thermoplastic resin is used. Furthermore, a method where the resin is coated directly onto the surface having peaks and valleys, a method where the resin is diluted with a solvent and coated directly onto the surface having peaks and valleys, etc. can be mentioned when a thermosetting

resin is used.

[0023] The shape of the resin layer formed on the surface having peaks and valleys varies depending on the viscosity of the resin, interfacial tension between the resin and prism, gravity, and, when coated as a solution, the concentration in the solvent, drying rate of the solvent, and when a thermosetting resin is used, shrinkage factor at the time of curing, etc., and formation of the resin layer is achieved upon adjustment of the aforementioned parameters to form a desired shape, and it is desirable when the cross-section has a curved surface that forms an arc, bow, or meniscus. Furthermore, it is desirable when the resin layer with the greatest thickness formed at the valley of the peaks and valleys, that is, the thickness of the valley of the resin layer is 2/3 or less the height of the peak member for the cross-section of the surface having peaks and valleys. Furthermore, the resin layer may cover all the way up to the peaks of the surface having peaks and valleys or just the recessed area as shown in Fig. 3.

[0024] The shape and arrangement of the peaks and valleys of the component having surface having peaks and valleys and the shape of resin layer, etc. are determined upon taking light transmittance and direction of transmittance from the rear into consideration when backlighting is used and light reflection efficiency, direction of reflection, and diffusion, etc. on the reflective type display from the viewing side when backlighting is not used.

[0025] The transmitting reflector of the present invention is arranged between the polarizing plate underneath the liquid crystal cell and light guide plate with the surface having peaks and valleys facing the light guide plate. A diffusion film, etc. may be arranged between the transmitting reflector of the present invention and light guide plate having the aforementioned arrangement, or the transmitting reflector of the present invention may be directly arranged on the light guide plate. Furthermore, diffusion film, diffusion adhesive, etc. may be arranged between the transmitting reflector and polarizing plate as well. Furthermore, when the rough shape is accompanied with shape anisotropy as in the case of prism film, it is necessary to arrange taking factors such as the shape of the light guide plate, direction of external light source

determined by the application of the liquid crystal display device, and direction of the polarizing axis of the lower polarizing plate and shape anisotropy into account. The transmitting reflector of the present invention is arranged directly or via an air layer on the glass of the liquid crystal cell or light guide plate or bonded with a conventional acrylic type adhesive, etc.

[0026] Furthermore, in a transmitting reflector type polarizing plate where a polarizing plate is arranged on the transmitting reflector of the present invention at the side opposite from the surface having peaks and valleys, the transmitting reflector of the present invention is arranged directly or via an air layer on the polarizing plate or bonded with a conventional acrylic type adhesive, etc. to form a transmitting reflector type polarizing plate suitable for a TN type or STN type transmission reflection type liquid crystal display device. Furthermore, when the aforementioned transmitting reflector type polarizing plate is mounted in a liquid crystal display device with the aforementioned arrangement, a transmission reflection type liquid crystal display device with high viewability can be produced.

[0027]

[Effect of the invention] The transmitting reflector and transmitting reflector type polarizing plate of the present invention and transmission reflection type liquid crystal display device utilizing the same has higher brightness and higher viewability when used as reflective type display device than conventional liquid crystal display devices. Furthermore, when used as transmission type device, higher light transmission and brightness of the display are made possible, and when used for portable equipment run by batteries, long-term usage is made possible.

[0028]

[Working Examples] The present invention is explained in further detail with the working examples below, but the present invention is not limited to working examples shown. Furthermore, the transmittance and reflectance of light in the present invention are defined as the total light transmission factor and total light reflection factor measured according to the

specification JIS K-7105 after laminating the transmitting reflector and a polarizing plate [SQ-1852A: product of Sumitomo Chemical Co., (Ltd.)] and the arrangement is such that the polarizing plate faces the integrating sphere at all times. Approximately 50% of light is absorbed by the polarizing plate, thus, the maximum value for the total light transmission factor and total light reflection factor, individually, is approximately 50%. Thus, when the sum of the transmittance and reflectance exceeds 50%, the total value of the transmittance and reflectance for natural light exceeds 100% when light absorption by the polarizing plate is taken into consideration. The transmitting reflector of the present invention was arranged on the edge-lighting system with wedge-shaped light guide plate for a 10.4-inch liquid crystal panel installed in a dark room, and measurements were made for the surface brightness at a distance of 50 cm from the surface of the light guide plate in a direction normal to the light exiting surface of the light guide plate using a luminance meter (BM-8: product of Topcon Co.). The surface brightness under transmission state (hereinafter referred to as transmission surface brightness) was measured by turning on the light of the cold cathode tube in the light guide plate. The surface brightness under a reflection state (hereinafter referred to as reflective brightness) was measured by turning off the lights of the cold cathode tube in the light guide plate, and using an inverter system fluorescent electric lamp [BS3171H: Mitsubishi Electric Co.] arranged at an angle from the normal to the light guide plate of 30° and at a distance from the light source to the sample surface of 45 cm, and parallel to the cold cathode tube of the light guide plate, thus, parallel to the recesses of the prism as well, and the reflective luminance was measured.

[0029] Working Example 1

A 10% aqueous solution of polyvinyl alcohol (PVA117: product of Kuraray Corp.) was coated onto a prism surface of a prism film BEFII90/50 [product of Sumitomo 3M Co.] having a cross-section shape of a triangle having an apex of 90°C and distance between apexes of 50 μm using a glass bar, and water was evaporated to produce a polyvinyl alcohol layer. The coating process was repeated two times to produce a transmitting reflector. The cross-section view of the

transmitting reflector produced is shown in the optical photograph of Fig. 4, and as shown, a meniscus-shaped PVA layer was formed, and the thickness at the lowest portion of the PVA layer was 2/3 or less of the height of the peak member of the prism. The reflectance and transmittance of the BEFII90/50 before coating of polyvinyl alcohol was 34.9% and 38.2%, respectively, and the sum of reflectance and transmittance was 73.1%. When the absorption by the polarizing plate is taken into consideration, the sum of reflectance and transmittance was greater than 100%. Furthermore, when measurements were made for the reflectance and transmittance of the transmitting reflector , values of 25.3% and 41.4% were achieved, respectively, and the sum of reflectance and transmittance was 66.7%. When the absorption by the polarizing plate is taken into consideration, the sum of reflectance and transmittance was greater than 100%. Furthermore, a light guide plate, the transmitting reflector produced, and a polarizing plate [SQ-1852A: product of Sumitomo Chemical Co., Ltd.] were laminated in the stated order in such a manner that the recesses of the prism of the BEFII90/50 were parallel to the cold cathode tube of the light guide plate and when measurements were made of the front-side transmission luminance and front-side reflection luminance, 252 cd/m^2 and 320 cd/m^2 were obtained, respectively. Furthermore, a light guide plate, the transmitting reflector produced, a polarizing plate, liquid crystal cell, and another polarizing plate were laminated and used as a semi-transmitting reflector type liquid crystal display; and a semi-transmitting reflector type liquid crystal display device with high front-side transmission luminance and high front-side reflection luminance was produced.

[0030] Comparative Example 1

The reflectance and transmittance of semi-transmitting reflector AS011 [product of Sumitomo Chemical Co., Ltd., light transmittance 31.1%] were 19.2% and 12.9%, respectively, and the sum of reflectance and transmittance was 32.0%. The sum of reflectance and transmission factor was less than 100% when absorption by the polarizing plate was taken into consideration. Furthermore, a light guide plate, the semi-transmitting reflector, and a polarizing plate were

laminated in the stated order and when measurements were made for the front-side transmission luminance and front-side reflection luminance, 152 cd/m^2 and 345 cd/m^2 were achieved, respectively.

[0031] Comparative Example 2

In Working Example 1, coating of the BEFII90/50 with polyvinyl alcohol was omitted. The reflectance and transmittance of the BEFII90/50 measured according to Working Example 1 were 34.9% and 38.2%, and the sum of the reflectance and transmittance was 73.1%. When absorption of the polarizing plate was taken into consideration, the sum of reflectance and transmittance exceeded 100%. Furthermore, a light guide plate, BEFII film and polarizing plate [SQ-1852A: product of Sumitomo Chemical Co., Ltd.] were laminated in the stated order in such a manner that the recesses of the prisms of the BEFII90/50 were parallel to the cold cathode tube of the light guide plate and when measurements were made for the front-side transmission luminance and front-side reflection luminance, values of 56 cd/m^2 and 74 cd/m^2 were obtained, respectively, and in comparison to AS011, reductions in front-side transmission luminance and front-side reflection luminance were observed.

[0032] Working Example 2

Polyvinyl alcohol solution was coated three times and production of a transmitting reflector was achieved as in Working Example 1. When measurements were made of the reflectance and transmittance of the resulting transmitting reflector, values of 21.9% and 41.3% were achieved, respectively, and the sum of reflectance and transmittance was 66.7%. When absorption of the polarizing plate was taken into consideration, the sum of reflectance and transmittance exceeded 100%. Furthermore, a light guide plate, transmitting reflector produced and polarizing plate [SQ-1852A: product of Sumitomo Chemical Co., Ltd.] were laminated in the stated order in such a manner that the recesses of the prism of the BEFII90/50 were parallel to the cold cathode tube of the light guide plate, and, when measurements were made for the front-side transmission luminance and front-side reflection luminance, values of 427 cd/m^2 and 486 cd/m^2 were

obtained, respectively. Furthermore, a light guide plate, the transmitting reflector produced, a polarizing plate, liquid crystal cell, and another polarizing plate were laminated and used as a semi-transmitting reflector type liquid crystal display, and a semi-transmitting reflector type liquid crystal display device with high front-side transmission luminance and high front-side reflection luminance was produced.

[0033] Working Example 3

Alumina fine particles [Sumi-Corundum AA03, product of Sumitomo Chemical Co., Ltd., mean diameter 0.3 μm] were suspended in water and mixed with 10% solution of PVA to produce a solution of alumina fine particles:PVA:water=5:95:900 (weight ratio). The solution produced was then coated once onto the prism surface of the prism film as in the case of Working Example 1 to produce a transmitting reflector. When measurements were made for the reflectance and transmittance, values of 19.9% and 41.2% were obtained, respectively, and the sum of the reflectance and transmittance was 61.1%. When absorption of polarizing plate was taken into consideration, the sum of the reflectance and transmittance exceeded 100%. Furthermore, a light guide plate, the transmitting reflector produced, and a polarizing plate were laminated in the stated order in such a manner that the recesses of the prisms of the BEFII90/50 were parallel to the cold cathode tube of the light guide plate and when measurements were made for the front-side transmission luminance and front-side reflection luminance, values of 371 cd/m^2 and 304 cd/m^2 were obtained, respectively. Furthermore, a light guide plate, the transmitting reflector produced, polarizing plate, liquid crystal cell, and another polarizing plate were laminated and used as a semi-transmitting reflector type liquid crystal display, and a semi-transmitting reflector type liquid crystal display device with high front-side transmission luminance and high front-side reflection luminance was produced.

[0034] Working Example 4

A diffusion film (diffusion factor 36.1%) was laminated onto the flat surface side of the transmitting reflector of Working Example 1 to form a transmitting reflector. Furthermore, a

light guide plate, the transmitting reflector, and polarizing plate [SQ-1852A: product of Sumitomo Chemical Co., Ltd.] were laminated in the stated order in such a manner that the recesses of the prism of the BEFII90/50 were parallel to the cold cathode tube of the light guide plate and when measurements were made for the front-side transmission luminance and the front-side reflection luminance, values of 296 cd/m^2 and 206 cd/m^2 were obtained, respectively. Among the transmitting reflectors produced, the front-side reflection luminance of Comparative Example 1 was the poorest in comparison to those of semi-transmitting reflector of prior art according to the aforementioned evaluation method, but when light from the fluorescent lamp enters from a direction not parallel to the recesses of the prism film, a front-side reflection luminance comparable to that of the transmitting reflector described in Working Example 1 was achieved. When the transmitting reflector obtained was laminated in the order of light guide plate, transmitting reflector, light guide plate, liquid crystal cell, and polarizing plate and used as a semi-transmitting reflector type liquid crystal display device, a semi-transmitting reflector type liquid crystal display device with high front-side transmission luminance and high front-side reflection luminance was produced.

[Brief description of figures]

[Fig. 1] Semi-transmitting reflector of the prior art.

[Fig. 2] Transmission and reflection states for light incident on the surface having peaks and valleys without a resin layer.

[Fig. 3] Example of the transmitting reflector film having a resin layer on the surface having peaks and valleys of the present invention and light transmission and reflection state.

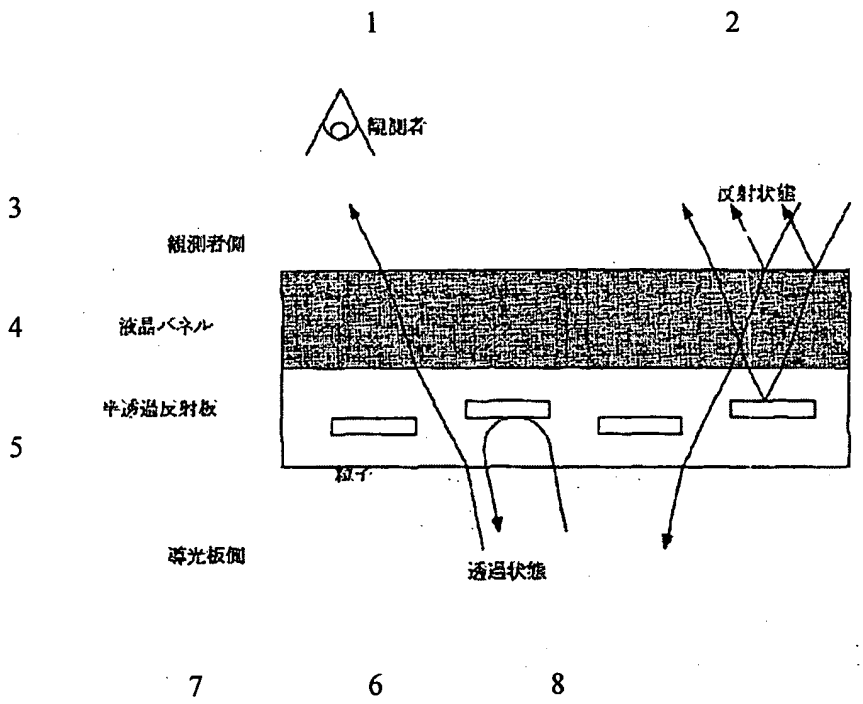
[Fig. 4] An embodiment of the transmitting reflector of a working example of the present invention shown as a cross-section view observed by an optical microscope.

[Explanation of codes]

(a): Locus of light transmission from rear

(b): Locus of incident light from the surface side

[Fig. 1]



Key:

1: Viewer

2: Viewing side

3: Reflection state

4: Liquid crystal panel

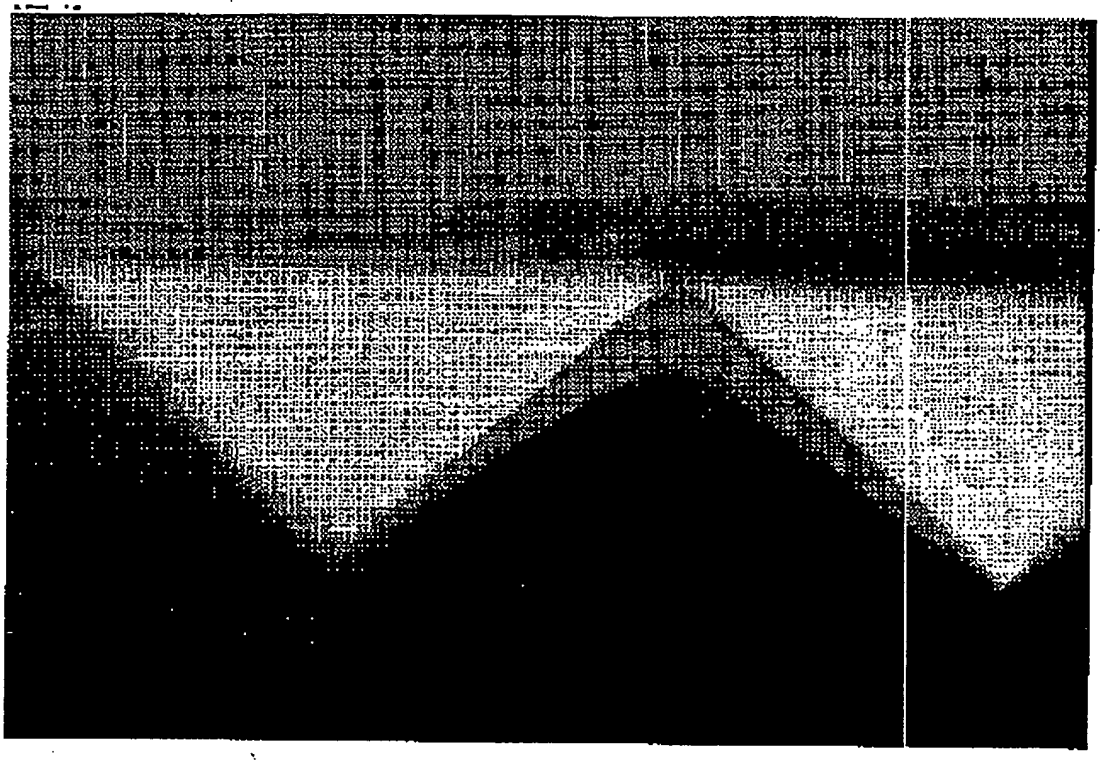
5: Semi-transmitting reflector

6: Particle

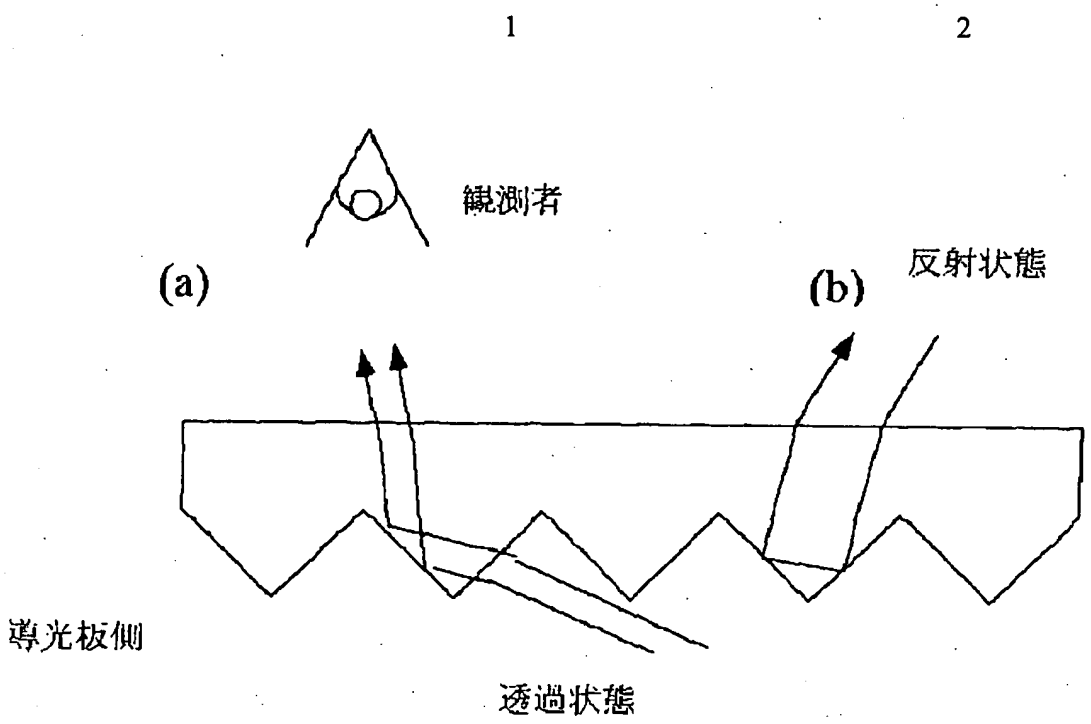
7: Light guide plate side

8: Transmission state

[Fig. 4]



[Fig. 2]



Key:

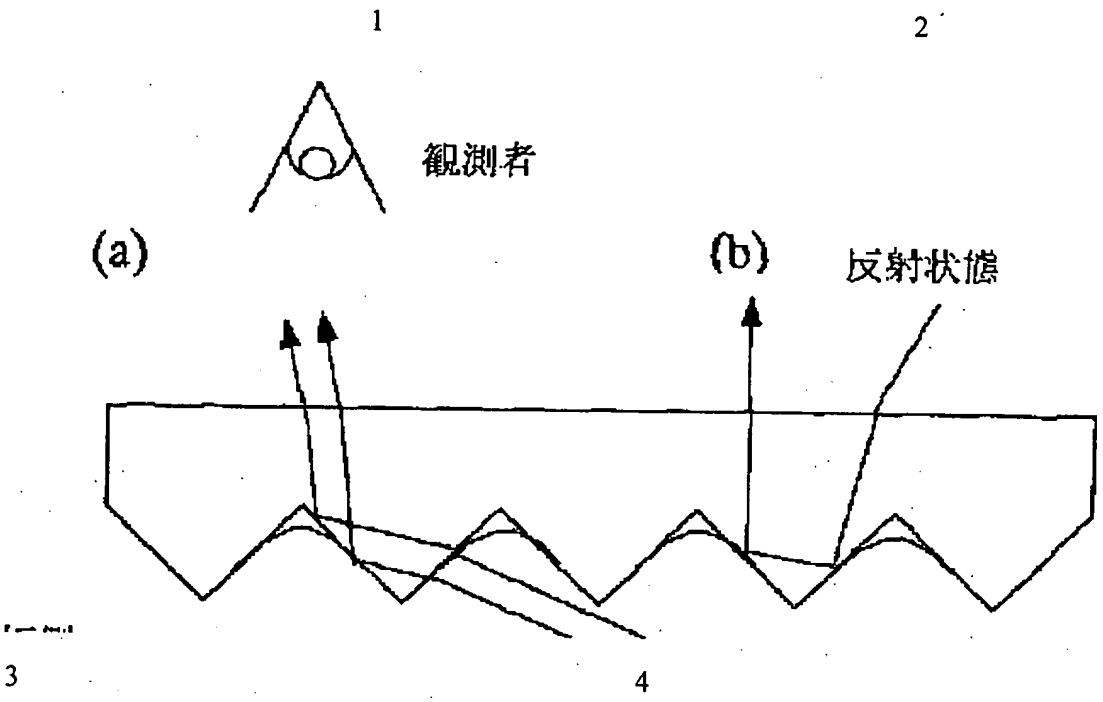
1: Viewer

2: Reflection state

3: Light guide plate side

4: Transmission state

[Fig. 3]



Key:

1: Viewer

2: Reflection state

3: Light guide plate side

4: Transmission state

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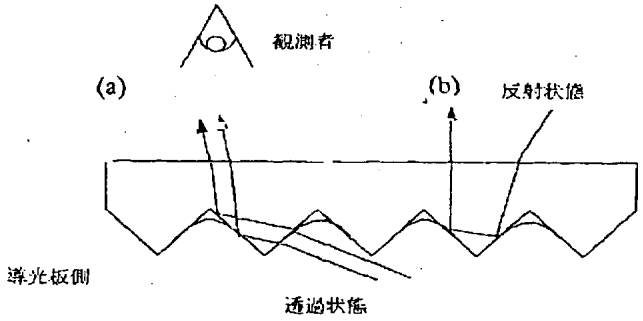
(71)出願人　000002093
住友化学工業株式会社
大阪府大阪市中央区北浜４丁目５番33号
(72)発明者　桑原　眞人
茨城県つくば市北原６　住友化学工業株式会社内
(72)発明者　前田　泰照
茨城県つくば市北原６　住友化学工業株式会社内
(74)代理人　100093285
弁理士　久保山　隆　（外２名）

最終頁に続く

(54)【発明の名称】　反射機能及び透過機能を有する光学部材

(57)【要約】
【課題】凹凸を有する透過反射板の正面方向における光の透過、反射性能、および拡散機能をバランス良く最適化し、透過反射型液晶表示装置に装着した場合に、透過型・反射型のどちらの場合でも明るさ、正面方向からの視認性の点で優れた透過反射板、透過反射型偏光板、およびそれを用いた透過反射型液晶表示装置を提供する。
【解決手段】（１）凹凸面を有し、凹凸面側からの光の透過率と、その反対側からの光の反射率との合計が１００％を超える平面状部材の観察者側とは逆の凹凸面に、樹脂層を形成してなる透過反射板。
（２）上記（１）記載の透過反射板に、樹脂層を形成した凹凸面とは反対側の面に偏光板を配置することを特徴とする透過反射型偏光板。
（３）上記（１）透過反射板、または上記（２）記載の透過反射型偏光板を、樹脂層を形成した凹凸面を背面照射型光源ユニットの光出射面方向に向けて該背面照射型光源ユニットの光出射面と液晶表示部との間に配置することを特徴とする透過反射型液晶表示装置。



【特許請求の範囲】
【請求項１】凹凸面を有し、該凹凸面側からの光の透過率と、その反対側からの光の反射率との合計が１００％を超える平面状部材の観察者側とは逆の凹凸面に、樹脂層を形成してなる透過反射板。
【請求項２】請求項１記載の凹凸面が再帰反射性を有することを特徴とする請求項１記載の透過反射板。
【請求項３】樹脂層が凹凸面の凹部側に凹みを有し、その断面が弧状、湾曲状又はメニスカスの曲面であり、樹脂層の谷部の厚みが凹凸形状断面の凸部の高さの２／３以下である請求項１又は２記載の透過反射板。
【請求項４】請求項１～３のいずれかに記載の透過反射板に、樹脂層を形成した凹凸面とは反対側の面に偏光板を配置することを特徴とする透過反射型偏光板。
【請求項５】請求項１～３のいずれかに記載の透過反射板、または請求項４記載の透過反射型偏光板を、樹脂層を形成した凹凸面を背面照射型光源ユニットの光出射面方向に向けて該背面照射型光源ユニットの光出射面と液晶表示部との間に配置することを特徴とする透過反射型液晶表示装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、高い透過率および反射率を実現する透過反射板、透過反射型偏光板、およびそれを用いてなる透過反射型液晶表示装置に関する。
【０００２】
【従来の技術】近年、液晶表示装置はノート型ワープロ、パソコンの他、電子手帳、携帯情報端末機、アミューズメント機器、携帯電話機等、多方面で利用されている。これらのうちで携帯機器は半透過反射型液晶表示装置が多く用いられている。半透過反射型液晶表示装置は昼間又は明るい場所では自然光あるいは室内光などを利用した反射型（以下反射状態と呼ぶ）として使い、夜間又は暗い場所ではバックライトを用いた透過型（以下透過状態と呼ぶ）として用いる。半透過反射型液晶表示装置としては、第１偏光板／液晶セル（ＴＮセル、ＳＴＮセル）／第２偏光板／半透過反射板／バックライトユニットの構成で配置したものなどが知られている。
【０００３】これらの表示装置に用いられる半透過反射板としては、屈折率の高いパールマイカなどの無機粒子をマトリックス中に分散させ、反射状態ではこれらの粒子により光を反射させ、透過状態ではこれらの粒子間から光を透過させることにより、反射機能と透過機能を両立させたものが知られている。例えば、特開昭５５－１０３５８３号公報には、光を反射する部分と光を透過する部分とが交互に配置されたパターンを形成した反射透過体が記載されている。別の例として、特開昭５５－４６７０７号公報には、接着材料層に酸化アルミニウム、酸化チタン、アルミニウム粉、スズ粉、金粉、銀粉などの透明および／または半透明粒子を均一に分散してなる半透過反射型偏光板が開示されている。上記とは別の方式としては、実開平５－５９４０４号公報および特開平１１－２２４０５８号公報には、本発明と同様にプリズムシートをバックライト側に向けて配置し、バックライト光をプリズム頂点側から透過する方式の液晶表示装置が開示されている。
【０００４】また、特開平９－３１１３３２号公報には、本発明と同様にプリズムシートを背面側に向けて配置し、透過光はプリズム頂点側から透過し、前面光はプリズム内部で反射して、透過性能ならびに反射性能を両立しようとした液晶表示装置が開示されている。
【０００５】
【発明が解決しようとする課題】しかしながら、特開昭５５－１０３５８３号公報および特開昭５５－４６７０７号公報記載のような、粒子の散乱等による透過光、反射光の分配を行なう方式では、透過性能と反射性能とがトレードオフ関係にあるため、それらの半透過反射板を半透過反射型液晶表示装置に装着して駆動した場合、明るさ、視認性の点で必ずしも十分なものではなかった。即ち、図１は従来のパールマイカなど屈折率の高い無機粒子や、金属などの反射率の高い粒子などをマトリックスに分散させた従来の半透過反射板の原理を示す図である。図１の下方向が背面に、上方向が観測者側に該当する。図１に示すように、従来の半透過反射板においては背面からの光の一部分は無機粒子や金属粒子により反射されて再び背面に戻るため、透過状態で使用する場合は実質的には粒子の隙間から漏れてくる光のみを使っており、光の利用効率が悪く透過率を高くできない問題があった。即ち、高い透過率を得るためには粒子の含量を下げて透過率を上げる必要があるため反射率が低下する。また、逆に反射率を上げるためには粒子の含量を上げる必要があり、その場合は透過率が下がる問題がある。従って、従来の半透過反射板においては透過率と反射率の和は１００％以下になっていた。加えて、ＴＮ、ＳＴＮなどの液晶表示方式において透過反射型表示とするためにはバックライトシステムを利用することが一般的であるが、バックライトシステムを利用する場合は導光板からの出射光はある程度指向性があり、また、外部光を利用する際も指向性が強い光を利用する場合が想定される。指向性の強い光源の場合、光の強度が大きい出射方向の表示と、光の強度が小さい出射方向の表示では輝度が大きく異なるため、視認性が低下する問題がある。従って、透過型、反射型のどちらの場合においても指向性を緩和し視認性を改良するため、透過、反射性能のどちらも高性能に保ちつつ、拡散機能をも付与する必要がある。しかし、実開平５－５９４０４号公報あるいは特開平１１－２２４０５８号公報には、プリズムシートの平滑面を観測者側に、プリズム面を導光板に向けて配置し、プリズムの屈折及び反射を利用して導光板からの出射光を観測者側の正面方向に集光してバックライト光源

の利用効率を高めた透過型液晶表示装置が記載されているが、バックライト光源を利用せず、観測者側からの光をプリズムの全反射により利用するという反射型表示装置としての使用の発想はなく、反射型での使用におけるプリズム反射光の指向性を緩和するための拡散板の設計も考慮されてない。

【０００６】次に、特開平９－３１１３３２号公報記載の方式の場合にも、プリズムシートの平滑面を観測者側に、プリズムシートのプリズム面を背面側に向けて配置してなる液晶表示装置が開示されている。該出願はプリズムによる全反射により観測者側の光を角度選択性を持たせて反射させ、液晶パネル背面側の光は角度選択性を持たせて観測者側に到達させることが特徴である。しかしながら、該出願はバックライトを用いずに、指向性の弱い外部周辺光を利用することを想定しているため、半透過反射型液晶表示装置で一般的であるバックライトを該出願に採用すると、指向性の強いバックライト光が液晶表示装置の正面以外の方向に強く屈折されるため、正面方向の輝度が低下してしまう。また、該出願は高分子分散型液晶による表示方式であり、高分子分散型液晶自身に光散乱性があるため、指向性の弱い外部周辺光を利用する場合は、拡散機能については高分子分散型液晶自身の光散乱性に依存させ、拡散板の使用については言及してない。

【０００７】本発明の目的は、凹凸を有する透過反射板の正面方向における光の透過、反射性能、および拡散機能をバランス良く最適化し、透過反射型液晶表示装置に装着した場合に、透過型・反射型のどちらの場合でも明るさ、正面方向からの視認性の点で優れた透過反射板、透過反射型偏光板、およびそれを用いた透過反射型液晶表示装置を提供することにある。

【０００８】

【課題を解決するための手段】本発明者らは、上記課題を解決するために鋭意検討した結果、凹凸面を有し、凹凸面側からの光の透過率と、その反対側からの光の反射率との合計が１００％を超える平面状部材の背面側、すなわち、観察者側とは逆の凹凸面に樹脂層を形成することで、反射状態・透過状態のいずれの場合においても、正面方向で明るく視認性が優れている光学部材を得ることができることを見出し、本発明を完成するに至った。

【０００９】すなわち、本発明は、以下の（１）から（３）を提供する。

（１）凹凸面を有し、凹凸面側からの光の透過率と、その反対側からの光の反射率との合計が１００％を超える平面状部材の観察者側とは逆の凹凸面に、樹脂層を形成してなる透過反射板。

（２）上記（１）記載の透過反射板に、樹脂層を形成した凹凸面とは反対側の面に偏光板を配置することを特徴とする透過反射型偏光板。

（３）上記（１）透過反射板、または上記（２）記載の透過反射型偏光板を、樹脂層を形成した凹凸面を背面照射型光源ユニットの光出射面方向に向けて該背面照射型光源ユニットの光出射面と液晶表示部との間に配置することを特徴とする透過反射型液晶表示装置。

【００１０】

【発明の実施の形態】次に本発明を詳細に説明する。以下、本発明の光学部材について、図を用いて説明するが、本発明は図示された例に限定されるものではない。

【００１１】凹凸面として断面が直角二等辺三角形の再帰反射性の凹凸を表面に形成したプリズムシートを用いた場合を例にとって本発明を説明する。図２は、再帰反射性の凹凸の断面図であり、図の下方向が液晶ディプレイの背面（バックライト）側に、反対方向の上方向が観測者側に該当する。このような形状のプリズムシートとしては、ミネソタ・マイニング・アンド・マニュファクチャリング（３Ｍ）社製の商品名「ＢＥＦII９０／５０」などが市販されている。図２でプリズム面側（背面側）から照射された光線は屈折して（ａ）のように大部分は透過する。一方、（ｂ）のようにプリズムが形成されていない平滑面側（観測者側）から入射された光線のうち、プリズムの材質の屈折率とプリズム角度から決まる臨界角以上でプリズム面に入射された場合は全反射し、さらにその反射光が他のプリズム面に臨界角以上で入射されると再び全反射され、その光線は平滑面側からプリズム形成面側からプリズムシート外部へ反射される。プリズムの材質の屈折率と光の入射方向によっては２回の反射とも全反射にすることが可能で、この場合は極めて反射率が高くなる。さらに上記ＢＥＦII９０／５０フィルムの断面は頂角が９０°の直角二等辺三角形であるため、プリズム列に直交する平面内から入射した入射光と反射光の方向は平行になり、再帰反射が起こる。従って、このような凹凸面を使うことにより、プリズム面側から照射された光の大部分は屈折してフィルムの平滑面側に出射し、平滑面側から照射された光の大部分は再帰反射により平滑面側に反射されるため、凹凸面側（背面側）からの光の透過率と、その反対側からの光の反射率との合計が１００％を越える優れた特性を有する透過反射板とすることが可能である。

【００１２】また、上記のようなプリズムフィルムで、頂角が９０°以外の場合では再帰反射は起こらないが、平滑面側からの入射光に対して全反射条件を満たすようにプリズム角を調整することが可能であり、反射率を高くすることができ、かつ凹凸面側から入射した光の透過率も高くすることが可能であり、反射率と透過率の合計が１００％を越える優れた特性を有する透過反射板とすることが可能である。このような透過反射板をバックライト付の液晶表示装置に装着して、半透過反射型の液晶表示装置とすることができ、周辺が暗く透過モードで使用するときは透過率が高く、周辺が明るくて反射モードで使用するときは反射率の高い、優れた透過反射型液晶

表示装置とすることができる。

【００１３】同様の作用は、プリズムシート以外の形状、例えば、多角錐や円錐状の突起形状であっても、その形状や材質の屈折率等を設計することにより達成できる。

【００１４】再帰反射とは、入射方向の広い範囲にわたって放射が入射方向に反射して帰るような反射の現象と光用語辞典(オーム社)では定義されているが、本発明で言う再帰反射は前述したようなある特定の平面内から入射した光に対してのみ起こる様な狭義の再帰反射も含まれる。また本発明では、反射光が完全に入射方向に帰るのではなく入射方向とほぼ平行な方向に帰るものであっても再帰反射とみなす。上記した狭義の再帰反射が起こるためにはプリズムフィルムの場合、頂角が９０°である必要があり、反射光が入射方向とほぼ平行な方向に帰る場合は９０°前後の頂角であってもよい。再帰反射性のプリズムを凹凸として使用した場合、プリズムが形成されていない平滑面側から入射した光はプリズムにより再帰反射するため、入射方向に反平行な方向に反射される。従って図２に示すようにフィルムの正面に近い方向から光が入射した場合は、フィルムの正面方向に光が反射されるが、フィルムの正面以外の方向から光がきた場合は、フィルムの正面方向に光が反射されない。半透過反射型の液晶表示装置が用いられる環境では、周囲の外部光の入射角は表示装置の法線方向から１０°から３０°ぐらいであることが一般的であるため、このような透過反射板を液晶表示装置に組み込んで使用した場合、表示装置の正面方向の輝度が高くならない課題があった。

【００１５】本発明では凹凸面を有する平面部材の背面側、すなわち、観察者側とは逆の凹凸面に樹脂層を形成する、樹脂層は例えば図３に示すような形で凹凸面の凹部側即ち、谷間に凹みを有して形成される。原理の詳細はよくわからないが、樹脂層の形成により反射率を大きく落とすことなく、プリズムフィルムの再帰反射性が弱まり、図３の上方、即ち、観測者側からくる自然光・室内光などの光でフィルムの法線以外の方向から入射した光も、フィルムの法線に近い方向に出射することを本発明者らは見いだした。また、図３に示すように下方（背面側）からきたバックライト光は樹脂層と、プリズム面で屈折され、フィルムの法線に近い方向に出射する。即ち、従来型の半透過反射板の難点であった、透過率と反射率の和が１００%以下であるという、透過率と反射率とのトレードオフ関係を打破して、透過状態・反射状態のどちらの場合でも光の利用効率が大幅に向上するとともに、反射状態においても、透過状態においても正面に近い方向に光が出射するような透過反射板とすることができる。

【００１６】本発明における、凹凸面を有し、凹凸面側からの光の透過率と、その反対側からの光の反射率との合計が１００%を超える平面状部材について、以下に説明する。言うまでもないが本発明は例示に限定されるものではない。

【００１７】本発明の平面状部材の凹凸形状としては、直円錐、斜円錐、角錐、斜角錐、楔型，凸多角体、半球状等から選ばれる構造、並びにそれらの部分形状を有する構造の少なくとも１種以上が挙げられる。なお、本発明で言う半球状は、必ずしもその表面形状は真球形状である必要は無く、楕円体形状や、より変形した凸曲面形状であっても良い。また、凹凸形状の稜線が線状に伸びた、プリズム形状、レンチキュラーレンズ形状、フレネルレンズ形状も挙げられる。その稜線から谷線にかけての斜面は平面状、曲面状、もしくは両者の複合的形状であっても良い。ここで言うプリズム形状の例として断面の形状が頂角９０°の直角二等辺三角形状のプリズムフィルムや、断面の頂角が８０～１１０°二等辺三角形状のプリズムフィルム、断面が不等辺三角形状のプリズムフィルム、断面が曲線でのプリズムフィルムなどが挙げられる。

【００１８】凹凸面の高さについては特に限定は無いが、例えば、液晶表示装置に用いる場合はパネル寸法に影響を与えない観点から１０μｍから１ｍｍ程度が好ましい。凹凸面の構成周期については特に限定は無いが、例えば、液晶表示装置に用いる場合はモアレや輝度むらの防止の観点から１μｍから１００μｍあるいは３００μｍから１ｍｍ程度が好ましい。

【００１９】本発明の凹凸面を形成する方法として、例えば、下記の方法などの公知の方法が挙げられる。

１）ロールや原盤に目的とする形状のネガ型を形成しておき、エンボスにて形状を付与する方法。

２）ロールや原盤に目的とする形状のネガ型を形成しておき、熱硬化性樹脂をネガ型に充填し、加熱硬化後ネガ型から剥離する方法。

３）ロールや原盤に目的とする形状のネガ型を形成しておき、紫外線または電子線硬化樹脂を塗布し凹部に充填後、樹脂液を介して凹版上に透明基材フィルムを被覆したまま紫外線または電子線を照射し、硬化させた樹脂とそれが接着した基材フィルムとをネガ型から剥離する方法。

４）目的とする形状のネガ型を流延ベルトに形成しておき、キャスティング時に目的とする形状を付与する溶剤キャスト法。

５）光または加熱により硬化する樹脂を透明基板に印刷し、光または加熱により硬化して凹凸を形成する方法。

６）表面を工作機械等で切削加工する方法。

７）球、多角体など各種形状の粒子を、基材表面に半ば埋没する程度に押し込んで一体化し、基材表面を凹凸形状にする方法。

８）球、多角体など各種形状の粒子を少量のバインダーに分散したものを基材表面に塗布し、基材表面を凹凸形状にする方法。

9）基材表面に、バインダーを塗布し、その上に球、多角体など各種形状の粒子を散布し、基材表面を凹凸形状にする方法。

【００２０】次に、本発明の凹凸面に形成する樹脂層について以下に説明する。前述したように、本発明の凹凸面の形状と、凹凸面の材質および光の入射角により全反射の条件が決まるが、凹凸面に形成する樹脂層の屈折率により全反射条件を調整することが可能である。凹凸面に形成する樹脂層の屈折率と、凹凸面の部材の屈折率の差は±０．２未満であることが好ましい。本発明の凹凸面に形成する樹脂層の種類は、熱可塑性樹脂や、光硬化性樹脂、電子線硬化樹脂等の放射線硬化樹脂、熱硬化性樹脂などが例示される。このような樹脂を単独で用いても良いし、混合して用いても良い。

【００２１】上記屈折率の条件を満たすような熱可塑性樹脂としてはポリメチルメタクリレート、ポリカーボネート、ポリスチレン、ポリビニルアルコール、ポリビニルブチラール、ポリエチレンテレフタレート、ポリスルホン、ポリアリレート、ポリエーテルスルホン、エチルセルロース、メチルセルロース、ニトロセルロース、２酢酸セルロース、３酢酸セルロース等の樹脂やアートン、ゼオネックス、ゼオノール等の商品名で知られる光弾性係数の小さい熱可塑性樹脂などが例示され、放射線硬化性樹脂、熱硬化性樹脂としては、ウレタンアクリレート系樹脂、エポキシアクリレート系樹脂、ウレタンメタクリレート系樹脂、エポキシメタクリレート系樹脂、アクリル系樹脂、エポキシ系樹脂、ポリエステル系樹脂、ウレタン系樹脂、アルキド系樹脂などが例示される。

【００２２】樹脂層の形成方法については、熱可塑性樹脂を用いる場合、樹脂を溶媒に溶解して凹凸面上に塗布する方法や、樹脂の軟化点以上に加熱して樹脂層を凹凸面上に形成するなどの公知の方法が例示される。光硬化性樹脂を用いる場合、凹凸面上に直接塗布する方法や、溶媒で希釈して凹凸面上に直接塗布する方法などの公知の方法が例示される。

【００２３】凹凸面に形成された樹脂層の形状は、樹脂の粘度、樹脂とプリズムの界面張力、重力、溶媒から塗布する場合は溶媒の濃度、溶媒の乾燥速度、硬化性の樹脂の場合は硬化時の収縮率、等により異なり、所望の形状にするためにはこれらのパラメーターを調節して樹脂層を形成すればよいが、凹凸面の凹部側に凹みを有し、その断面が弧状、湾曲状又はメニスカスの曲面であることが好ましい。また、凹凸の谷間に形成された樹脂層の最も厚い部分、即ち、谷部における樹脂層の厚みが、凹凸形状断面の凸部の高さの２／３以下であることが好ましい。また、樹脂層は凹凸の凸部まで覆っていてもよいし、図３に示すように凹凸の凹部だけに溜まるような形でもよい。

【００２４】本発明に用いる凹凸形状を有する部材の凹凸形状や配置、ならびに樹脂層の形状などは、最終的にはバックライトを使用する場合の背面からの光の透過効率・透過方向、バックライトを使用しない場合の反射型表示での観測者側からの光の反射効率・反射方向、および拡散性の最適化を考えて決定される。

【００２５】本発明の透過反射板は、液晶ディスプレイの液晶セルの下側偏光板と導光板間に凹凸面が導光板側を向くように配置される。このように配置された本発明の透過反射板と導光板の間には拡散フィルムなどが設置されていても良いし、導光板上に本願の透過反射板を直接設置しても良い。また、透過反射板と偏光板の間に拡散フィルム、拡散粘着剤などを設置してもよい。また、プリズムフィルムなどのように形状の異方性がある凹凸形状の場合、導光板の形状、液晶ディスプレイの用途などから決まる外部光源の方向、下側偏光板の偏光軸方向などと形状の異方性とを考慮して配置することが必要になる。本発明の透過反射板は、液晶セルのガラスや、導光板などの部材に密着もしくは空気層を介して配置するか、あるいは公知のアクリル系接着剤等で貼合して一体化して使用することが出来る。

【００２６】また、本発明の透過反射板の凹凸面とは反対側に偏光板を配置した透過反射型偏光板では、本願の透過反射板を偏光板に密着もしくは空気層を介して配置するか、あるいは公知のアクリル系接着剤等で貼合して一体化し、ＴＮ型、ＳＴＮ型等の透過反射型液晶表示装置に適した透過反射型偏光板とすることができる。そして、このような透過反射型偏光板を上述した配置で液晶表示装置に装着することにより、視認性が優れた透過反射型液晶表示装置が得られる。

【００２７】

【発明の効果】本発明の透過反射板、透過反射型偏光板およびそれを用いた透過反射型液晶表示装置は、反射型で使用した場合、従来の液晶表示装置に比べ、明るく視認性が優れている。また、透過型で使用した場合には、従来の半透過反射板と比較して透過光量が大きく、明るい表示が可能であり、また、バッテリー駆動の携帯表示機器などに用いる場合には長時間使用することが可能になる。

【００２８】

【実施例】以下実施例を用いて本発明を更に詳細に説明するが、本発明は実施例に限定されるものではない。なお、本発明の光の透過率、反射率は透過反射板と偏光板［ＳＱ－１８５２Ａ：住友化学工業（株）製］とを積層したのち、偏光板が常に積分球側になるように配置してＪＩＳ　Ｋ－７１０５により測定した全光線透過率、全光線反射率で規定する。偏光板により約５０％の光が吸収されるため全光線透過率および全光線反射率の最大値はそれぞれ約５０％となる。従って本実施例中で透過率と反射率の合計が５０％を越えた場合、偏光板での光吸収を考慮すると自然光に対する透過率と反射率の合計値

は１００％を越えることになる。本願の透過反射板を暗室内に設置した１０．４インチ液晶パネル用のエッジライト式楔形導光板上に設置して、導光板の出射面の法線方向に導光板表面から５０ｃｍの距離のところに設置した輝度計（ＢＭ－８：トプコン製）にて正面輝度を測定した。透過状態の正面輝度（以下、透過正面輝度）は導光板の冷陰極管を点灯して測定した。反射状態の正面輝度（以下、反射正面輝度）は、導光板の冷陰極管を消灯して、導光板の法線方向から３０°で、サンプル表面から光源の距離が４５ｃｍになり、導光板の冷陰極管の相対する方向に平行に設置し、従ってプリズムの溝にも平行になるよう設置したインバーター方式の蛍光灯電気スタンド［ＢＳ３１７１Ｈ：三菱電気照明（株）製］にて照明した場合の反射輝度を測定した。

【００２９】実施例１

断面が頂角９０°の三角形状で、頂点間距離が５０μｍであるプリズムフィルムＢＥＦII９０／５０［住友スリーエム株式会社製］のプリズム面に、ポリビニルアルコール（ＰＶＡ１１７：クラレ製）の１０％水溶液をガラス丸棒を用いて塗布し、水を蒸発させてポリビニルアルコール層を形成した。塗布工程を２回繰り返し、透過反射板を得た。得られた透過反射板の断面の光学顕微鏡写真を図４に示すようにメニスカス状のＰＶＡ層が形成されており、ＰＶＡ層の最も低い部分の厚みはプリズム凸部の高さの２／３以下であった。ポリビニルアルコール塗布前のＢＥＦII９０／５０フィルムの反射率、透過率はそれぞれ、３４．９％、３８．２％になり反射率透過率の合計値は７３．１％であった。偏光板による吸収を考慮すると反射率・透過率の合計は１００％を越えていた。また、得られた透過反射板の反射率、透過率を測定したところそれぞれ２５．３％、４１．４％になり、反射率と透過率の合計は６６．７％であった。偏光板の吸収を考慮すると反射率と透過率の和の合計は１００％以上になった。次に、得られた透過反射板でＢＥＦII９０／５０フィルムのプリズムの溝が導光板の冷陰極管と平行になるよう、導光板、透過反射板、偏光板［ＳＱ－１８５２Ａ：住友化学工業（株）製］の順に積層し、透過正面輝度・反射正面輝度を測定したところそれぞれ２５２ｃｄ／ｍ²、３２０ｃｄ／ｍ²であった。得られた透過反射板を導光板、透過反射板、偏光板、液晶セル、偏光板の順に積層して半透過反射型の液晶表示装置とすると、透過正面輝度と反射正面輝度の高い半透過反射型の液晶表示装置となる。

【００３０】比較例１

半透過反射板ＡＳ０１１［住友化学工業（株）製、光線透過率３１．１％］の反射率、透過率はそれぞれ１９．２％、１２．９％であり、反射率と透過率の合計は３２．０％であった。偏光板の吸収を考慮しても反射率と透過率の和は１００％以下であった。この半透過反射板を、導光板、半透過反射板、偏光板の順に積層して、透過正面輝度・反射正面輝度を測定したところ、それぞれ１５２ｃｄ／ｍ²、３４５ｃｄ／ｍ²であった。

【００３１】比較例２

実施例１記載のＢＥＦII９０／５０フィルムにポリビニルアルコールを塗布せずにそのままで用いた。実施例１記載の通りＢＥＦII９０／５０フィルムの反射率、透過率はそれぞれ、３４．９％、３８．２％になり反射率透過率の合計値は７３．１％であった。偏光板の吸収を考慮すると反射率と透過率の和の合計は１００％以上になった。ＢＥＦII９０／５０フィルムの溝が導光板の冷陰極管と平行になるよう、導光板、ＢＥＦＩＩフィルム、偏光板［ＳＱ－１８５２Ａ：住友化学工業（株）製］の順に積層し、透過正面輝度、反射正面輝度を測定したところそれぞれ５６ｃｄ／ｍ²、７４ｃｄ／ｍ²であり、ＡＳ０１１と比較して透過正面輝度、反射正面輝度とも低くなった。

【００３２】実施例２

ポリビニルアルコール溶液を３回塗布した以外は実施例１と同様にして透過反射板を得た。得られた透過反射板の反射率、透過率を測定したところそれぞれ２１．９％、４１．３％になり、反射率と透過率の合計は６６．７％であった。偏光板の吸収を考慮すると反射率と透過率の和の合計は１００％以上になった。次に，得られた透過反射板でＢＥＦII９０／５０フィルムのプリズムの溝が導光板の冷陰極管と平行になるよう、導光板、透過反射板、偏光板［ＳＱ－１８５２Ａ：住友化学工業（株）製］の順に積層し、透過正面輝度、反射正面輝度を測定したところそれぞれ４２７ｃｄ／ｍ²、４８６ｃｄ／ｍ²であった。得られた透過反射板を導光板、透過反射板、偏光板、液晶セル、偏光板の順に積層して半透過反射型の液晶表示装置とすると、透過正面輝度と反射正面輝度の高い半透過反射型液晶表示装置となる。

【００３３】実施例３

散乱性の微粒子としてアルミナ微粒子［スミコランダムＡＡ０３：住友化学工業（株）製、数平均粒径０．３μｍ］を水に懸濁させ、ＰＶＡ１０％水溶液と混合することで、アルミナ微粒子：ＰＶＡ：水＝５：９５：９００（重量比）の溶液とした。得られた溶液を実施例１と同様にプリズムフィルムのプリズム面に１回塗布して、透過反射板を得た。得られた透過反射板の反射率、透過率を測定したところそれぞれ１９．９％、４１．２％になり、反射率と透過率の合計は６１．１％であった。偏光板の吸収を考慮すると反射率と透過率の和の合計は１００％以上になった。次に，得られた透過反射板でＢＥＦフィルムのプリズムの溝が導光板の冷陰極管と平行になるよう、導光板、透過反射板、偏光板の順に積層し、透過正面輝度・反射正面輝度を測定したところそれぞれ３７１ｃｄ／ｍ²、３０４ｃｄ／ｍ²であった。得られた透過反射板を導光板、透過反射板、偏光板、液晶セル、偏光板の順に積層して半透過反射型の液晶表示装置とする

と、透過正面輝度と反射正面輝度の高い半透過反射型液晶表示装置となる。

【００３４】実施例4

実施例１の透過反射板の平滑面側に拡散フィルム［ヘイズ３６．１％　］を積層し透過反射板とした。次に，得られた透過反射板でＢＥＦII９０／５０フィルムのプリズムの溝が導光板の冷陰極管と平行になるよう、導光板、透過反射板、偏光板［ＳＱ－１８５２Ａ：住友化学工業（株）製］の順に積層し、透過正面輝度、反射正面輝度を測定したところそれぞれ２９６ｃｄ／m^2、２０６ｃｄ／m^2であった。得られた透過反射板では前述した評価法では，比較例１に示すように反射正面輝度が従来の半透過反射板と比較して劣っていたが、前述したようなプリズムフィルムの溝に平行にならない方向から蛍光燈電気スタンドの光が入射した場合には、実施例１記載の透過反射板より反射正面輝度が高くなることを目視で確認した。得られた透過反射板を導光板、透過反射板、偏光板、液晶セル、偏光板の順に積層して半透過反射型の液晶表示装置とすると、透過正面輝度と反射正面輝度の高い半透過反射型液晶表示装置となる。

【図面の簡単な説明】

【図１】従来の半透過反射板を示す図。

【図２】樹脂層を形成しない凹凸面での光の透過、反射状態を示す図。

【図３】凹凸面に樹脂層を形成した本願の透過反射フィルムの一例と、光の透過反射状態を示す図。

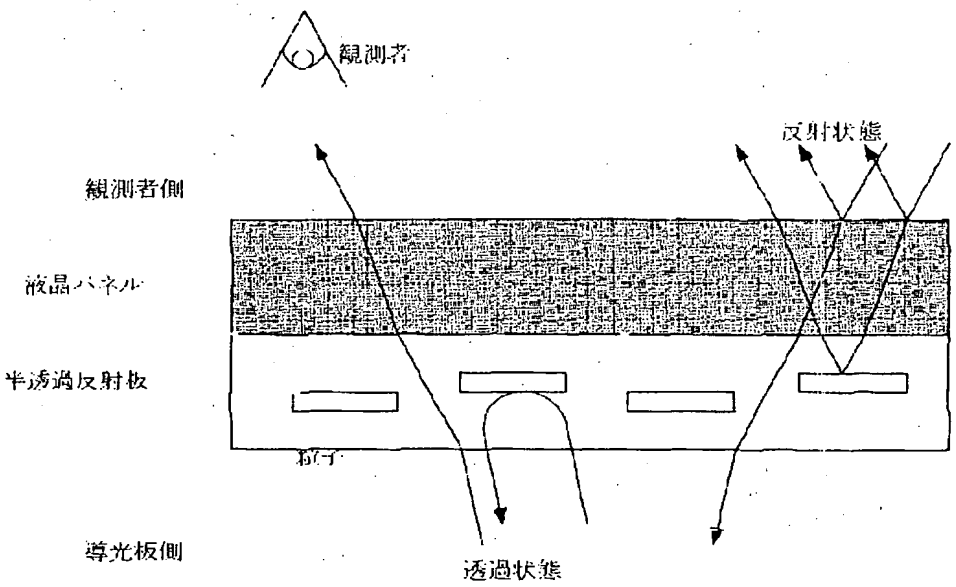
【図４】本発明の実施例の一つの様態を示す図であり、光学顕微鏡で観察した本発明の透過反射板の断面図である。

【符号の説明】

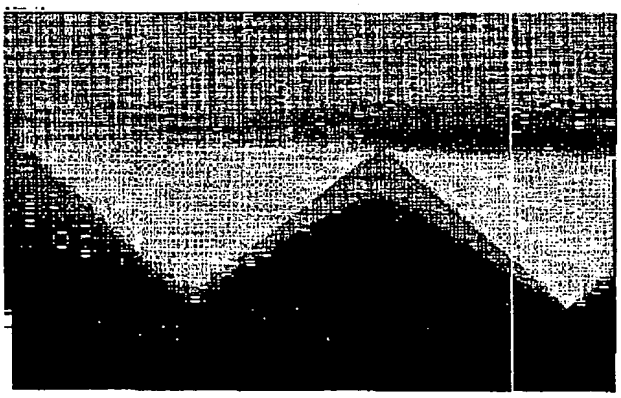
（ａ）：背面からの光の透過の軌跡

（ｂ）：表面側からの入射光の反射の軌跡

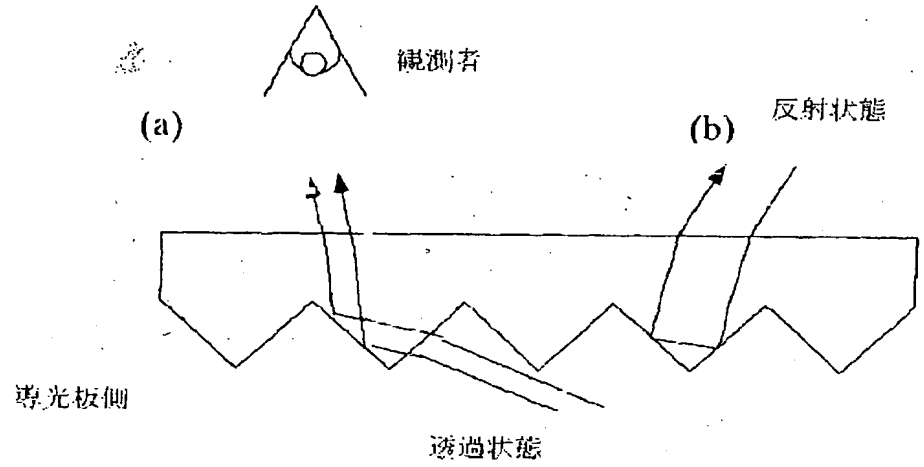
【図１】



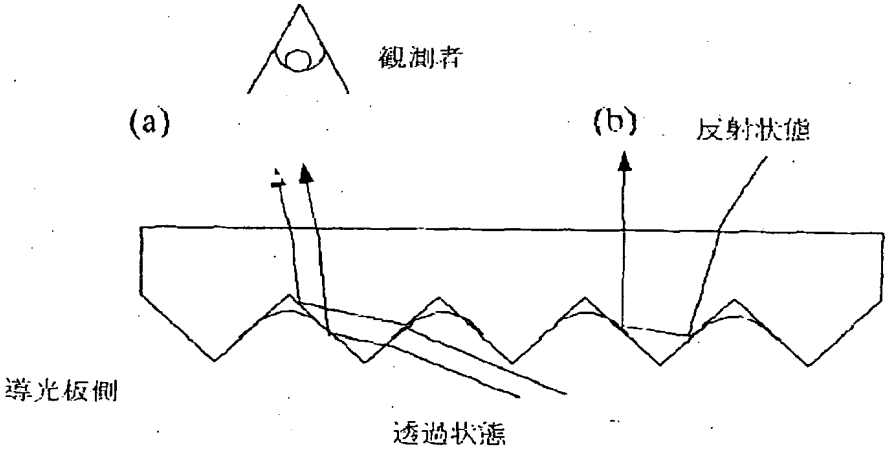
【図４】



【図2】



【図3】



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